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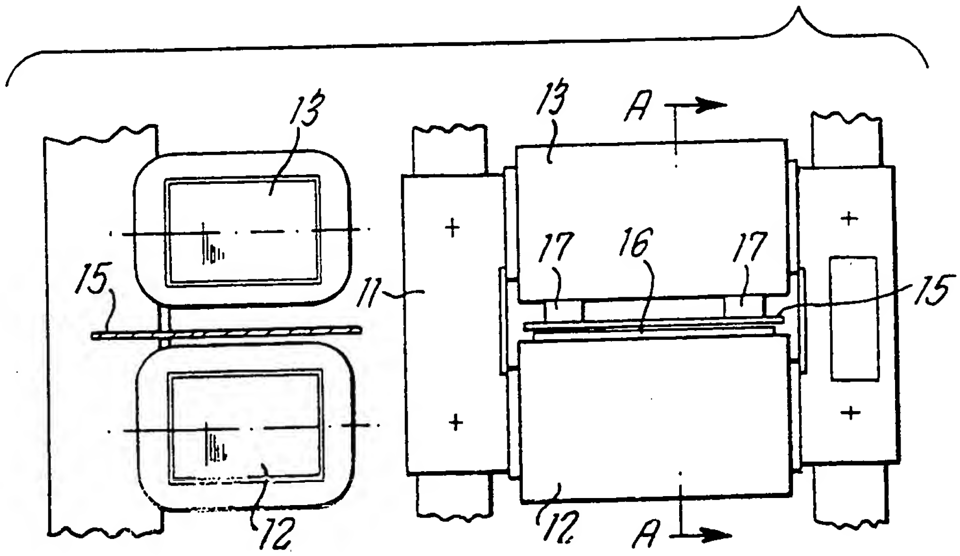
(54) Transformers for battery charging systems

(57) The transformer has a closed magnetic loop having two parallel limbs for, respectively the primary and secondary windings 12, 13. A magnetic shunt 15 is located in the space between the windings 12, 13 from which it is separated by insulating material 16, 17.

FIG.3



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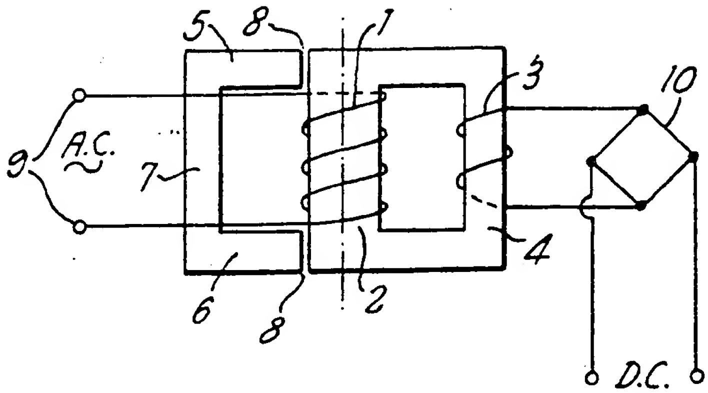


FIG. 1

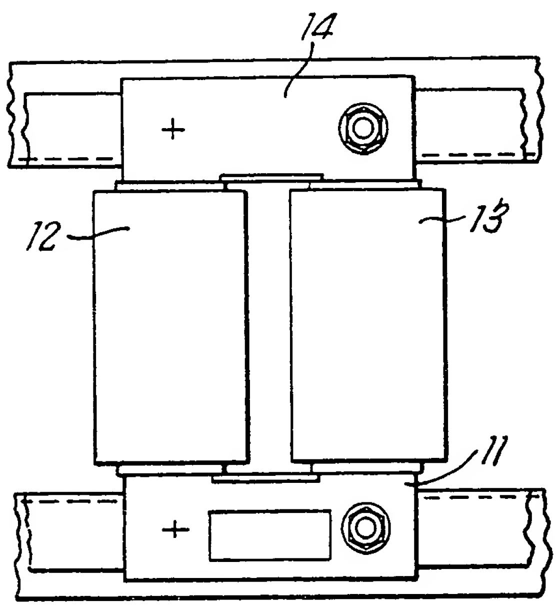
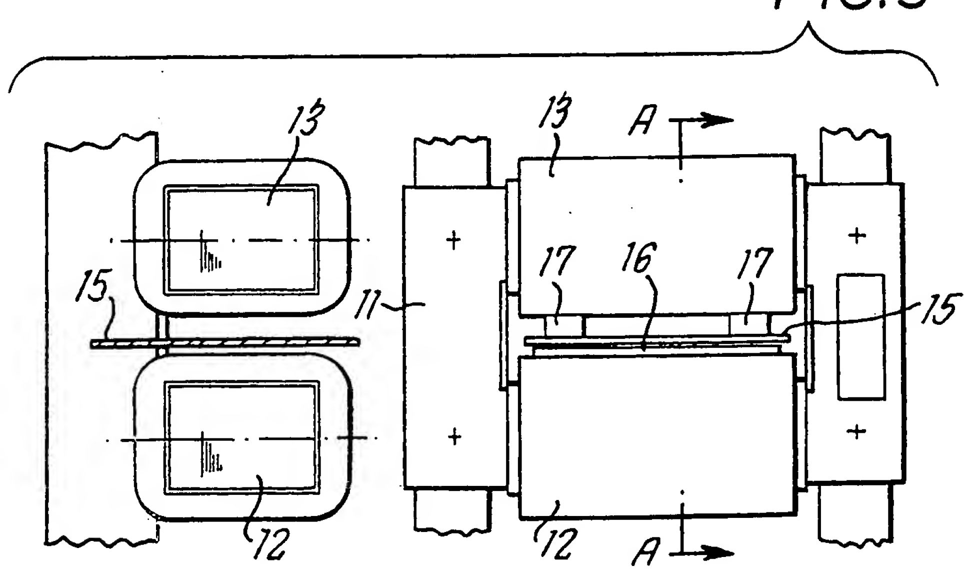


FIG. 2

FIG. 3



SPECIFICATION

Transformers for battery charging systems

This invention relates to transformers and particularly, but not exclusively, to transformers for use in a traction battery charging system.

A conventional battery taper charging system includes a mains-isolating transformer, a choke or resistor ballast in circuit with the transformer and a rectifier for providing the necessary D.C. current. An improvement of this arrangement is achieved if, instead of a separate choke ballast, the inductance is provided integrally with a shunt in the magnetic field generated by the windings of the transformer.

In the known arrangement, this is achieved by providing the transformer with three limbs arranged in spaced parallel relationship, the primary winding being on the middle limb, the secondary winding on one side limb and the middle limb being adjoined by the end of each arm of the other side limb with a preset or adjustable air gap. Such transformers have worked well but are expensive to manufacture and have a relatively large power loss and the present arrangement seeks to provide an improved transformer which overcomes or substantially reduces these disadvantages.

According to the present invention there is provided a transformer having a core in the form of a closed magnetic loop having first and second substantially parallel limbs, the primary winding being wound on one limb and the secondary winding being wound on the second limb, a magnetic shunt being located between the primary and secondary windings.

In the preferred form, the transformer core is formed from a plurality of laminations of a UI configuration in which the free ends of U-shaped laminations are closed by I-shaped laminations.

Preferably, the transformer is contained within a casing of a magnetic material such as steel since the radiated magnetic field is considerable. The casing controls the field and prevents modification of the output if any magnetic, e.g., ferric, material is placed near the transformer when in use.

A preferred embodiment of the present invention will now be described by way of example with reference to the accompanying drawings in which:—

Figure 1 shows a known form of transformer for use in a battery charger,

Figure 2 shows the basic transformer in accordance with the present invention and,

Figure 3 shows the transformer incorporating the magnetic shunt.

Referring now to Figure 1 there is shown a transformer having a core with three limbs in spaced parallel relationships formed of a plurality of laminations. The transformer has a primary winding 1 on a middle limb 2 and the secondary winding 3 on one side limb 4. On this side, which is the transformer side the magnetic circuit is a closed circuit. On the other side, the middle limb 2 is adjoined by the ends of arms 5, 6 of a second side limb 7 with air gaps 8 of preset widths. The limb 7 forms a magnetic shunt and the air gaps provide the required adjustment of inductance. The gap width is typically determined by the use of standard thickness shims of resin paper secured by clamping the two parts of the core i.e. the limb 7 and middle limb 2, together.

The primary winding 1 is connected to a source of alternating current at 9 via a battery charging control device (not shown) and the secondary winding 2 to a rectifier 10 whose output is connected to a battery which requires charging.

The magnetic shunt is used to give the magnetic core assembly the correct primary/secondary impedance to achieve the required volt/ampere taper. In practice, a number of different core sizes are produced, each size covering a predetermined range of cell/ampere outputs. To obtain a particular desired output, the appropriate core size is selected and the precise desired value within the range of the core is determined by setting the gaps 8 at an appropriate value during manufacture of the core assembly.

Figure 2 shows the basic configuration of the transformer in accordance with the present invention. The transformer core consists of a closed loop formed from a plurality of laminations of UI configuration. The core 11 thus consists of a plurality of U-shaped laminations having two substantially parallel limbs 12 and 13, the free ends of which are closed by a further limb 14 formed by the I of the UI configuration. In manufacturing the laminations the limb 14 is a straight section formed by the material stamped out from between the limbs 12 and 13 of the U-shaped part of the core. In this way, material wastage is virtually eliminated. The number of laminations in the core and the thickness of each individual lamination is selected to give the required characteristics for the transformer. As shown, the primary winding is wound on the limb 12 and the secondary winding is wound on the limb 13 with an air gap between the two windings.

As shown in Figure 3 a magnetic shunt 15 which consists of one or more thin iron sheets is located in the gap between the primary and secondary windings. The shunt 15 is insulated from the primary windings by a layer of insulating material 16 of known type and is located in position by packing wedges 17, also of insulating material, which are wedged between the shunt 15 and the secondary winding.

As in the known system described with reference to Figure 1, in carrying out the present invention, a number of different core sizes are produced each size having a predetermined range of cell/ampere outputs. However, in transformers in accordance with the present invention the primary/secondary impedance is determined by the geometry of the UI core and the associated winding assembly which thus provides the

required volt/ampere taper. The size of the core ass mbly determines the maximum cell/ampere capacity of each size of core and the magnetic shunts 15 are inserted during manufacture to give the selected cell/amp re output from within the range of the core. Thus if no shunt is fitted the maximum cell/ampere output of the core is obtained.

In use, the transformer is contained within a steel casing (not shown) since the radiated magnetic field is considerable. The casing controls the magnetic field and has the effect of reducing the transformer cell/ampere output. The casing provides the important advantage of preventing modification of the transformer characteristics, and hence the output of the battery charger, if any ferric material is placed near the transformer during a charging operation.

It has been found that the provision of this shunt in this type of leakage reactant transformer results in a considerable reduction in power loss in the transformer compared with the known three-limb type of transformer referred to earlier. The construction of the transformer is also considerably cheaper than the known type of transformer both in the amount of material required to form the core and also in the amount of labour required to form and assemble the transformer. The transformer is therefore not only more efficient than the known transformer in terms of its technical performance but is also considerably cheaper to manufacture.

Claims

1. A transformer having a core in the form of a closed magnetic loop having first and second substantially parallel limbs, the primary winding being wound on one limb and the secondary winding being wound on the second limb, a magnetic shunt being located between the primary and secondary windings.

2. A transformer as claimed in claim 1 wherein the core is formed from a plurality of laminations of a UI configuration in which the free ends of U-shaped laminations are closed by I-shaped laminations.

3. A transformer as claimed in claim 1 or 2 wherein the shunt is formed of one or more iron sheets.

4. A transformer as claimed in claim 1, 2 or 3 wherein the shunt is insulated from the windings by insulating material, at least part of which material consists of packing wedges for locating the shunt securely relative to the windings.

5. A transformer as claimed in any one of claims 1 to 4 including a steel casing enclosing the transformer to control the magnetic field thereof.

6. A transformer substantially as described herein with reference to and as illustrated in Figures 2 and 3 of the accompanying drawings.

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